

بِسْمِ اللَّهِ الرَّحْمَنِ الرَّحِيمِ

الحمد لله الذي هدانا لهذا الذي كنا لنهتدي لولا أن هدانا الله

Shiraz University
Faculty of Agriculture
Department of Horticultural Sciences

Seminar Topics:
**Mechanism of Stomatal closure by ABA and
inhibitor Compounds**

By:
Hossein gholami
December 2014

The chemical structures of ABA

ABA biosynthesis and metabolism

Developmental and physiological effects of ABA

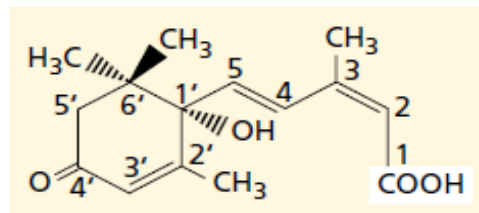
Changes in water potential, stomatal resistance and ABA content in response to water stress

Redistribution of ABA in the leaf resulting from alkalinization of the xylem sap during water stress

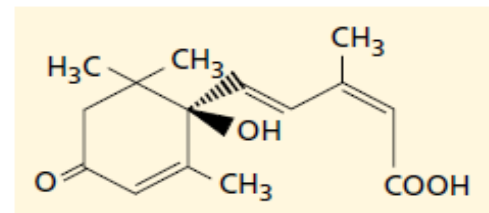
Inhibition of ABA-induced stomatal closure by fusicoccin is associated with cytosolic acidification-mediated hydrogen peroxide removal

Simplified model for ABA signaling in stomatal guard cells

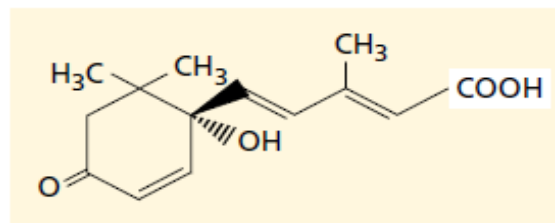
The chemical structures



(S)-cis-ABA
(naturally occurring
active form)



(R)-cis-ABA
(inactive in stomatal closure)



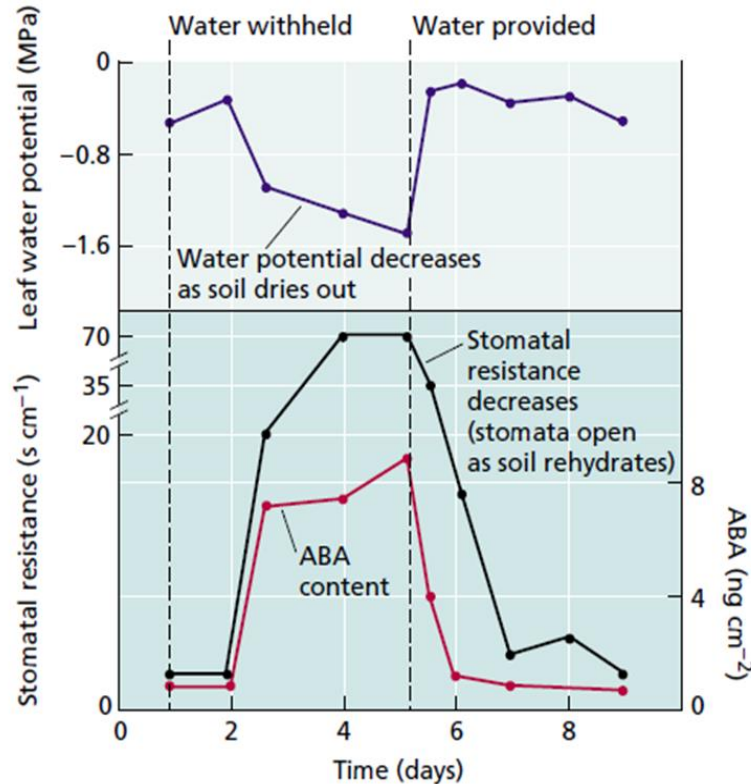
(S)-2-trans-ABA (inactive, but
interconvertible with active
[cis] form)



Developmental and physiological effects of ABA

- 1- ABA Levels in Seeds Peak during Embryogenesis**
- 2- ABA Inhibits Precocious Germination and Vivipary**
- 3- ABA Promotes the Accumulation of Seed Storage Protein during Embryogenesis**
- 4- ABA Promotes Desiccation Tolerance in the Embryo**
- 5- Seed Dormancy Is Controlled by the Ratio of ABA to GA**
- 6- ABA Inhibits GA-Induced Enzyme Production**
- 7- ABA Promotes Root Growth and Inhibits Shoot Growth at Low Water Potentials**
- 8- ABA Closes Stomata in Response to Water Stress**

Mechanism of Stomatal closure by ABA and inhibitor Compounds



Changes in water potential, stomatal resistance (the inverse of stomatal conductance), and ABA content in maize in response to water stress. As the soil dried out, the water potential of the leaf decreased, and the ABA content and stomatal resistance increased. The process was reversed by rewatering.

Upper epidermis

Palisade parenchyma

Mesophyll cells

Well-watered conditions pH 6.3

Acidic xylem sap favors uptake of the undissociated form of ABA (ABAH) by the mesophyll cells.

Xylem

ABAH

Water stress pH 7.2

ABA⁻

During water stress, the slightly alkaline xylem sap favors the dissociation of ABAH to ABA⁻.

Lower epidermis

Guard cell

Because ABA⁻ does not easily pass through membranes, under conditions of water stress, more ABA reaches guard cells.

Redistribution of ABA in the leaf resulting from alkalinization of the xylem sap during water stress.

Simplified model for ABA signaling in stomatal guard cells

Huang *et al. Botanical Studies* 2014, **55**:33
<http://www.as-botanicalstudies.com/content/55/1/33>

 **Botanical Studies**
a SpringerOpen Journal

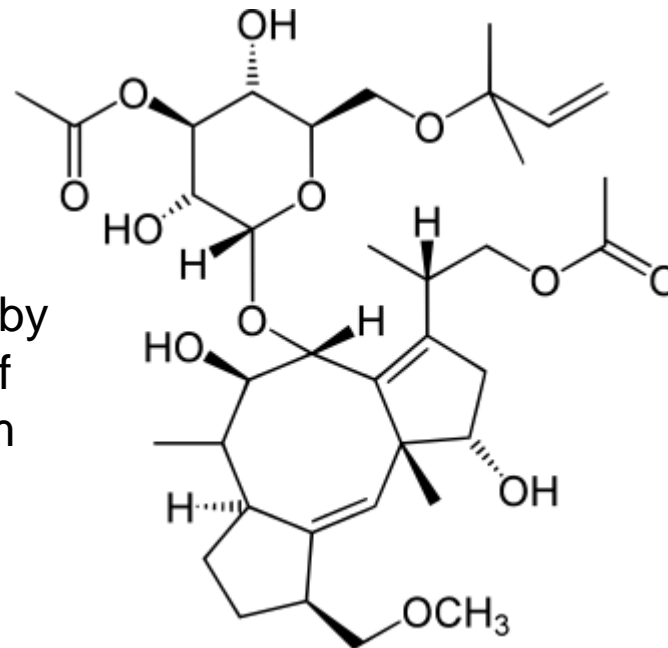
RESEARCH

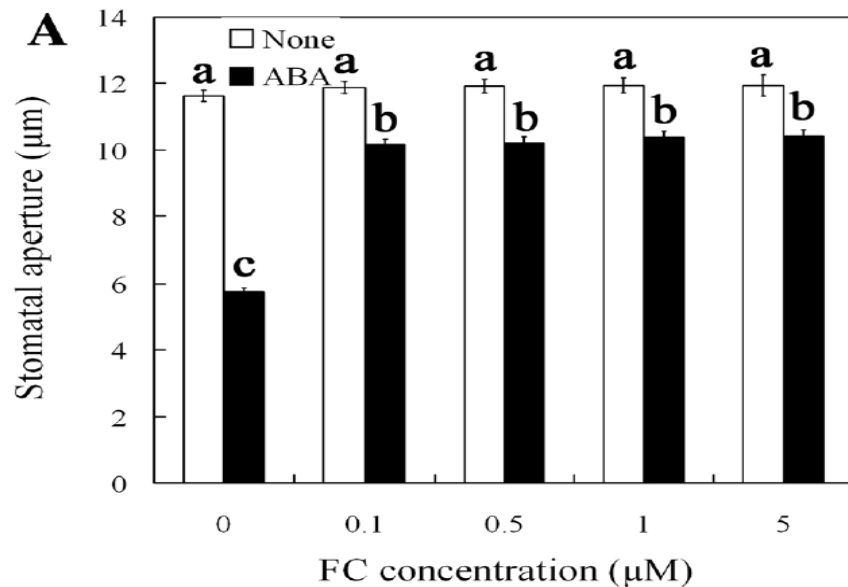
Open Access

Inhibition of ABA-induced stomatal closure by fusicooccin is associated with cytosolic acidification-mediated hydrogen peroxide removal

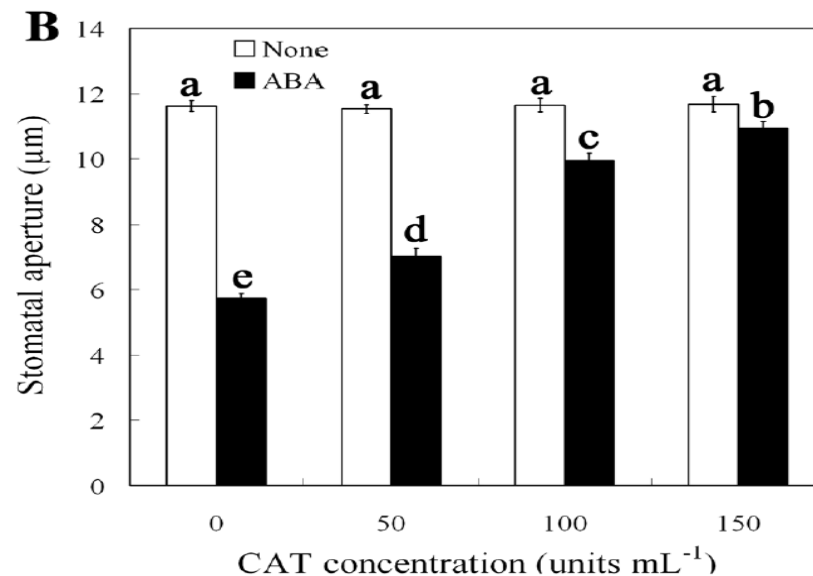
Ai-Xia Huang, Xiao-Ping She*, Jin-Liang Zhao and Yun-Ying Zhang

Fusicoccin (FC), a fungal phytotoxin produced by *Fusicoccum amygdale*, causes the inhibition of ABA-induced stomatal closure. The mechanism of inhibition is remaining unclear

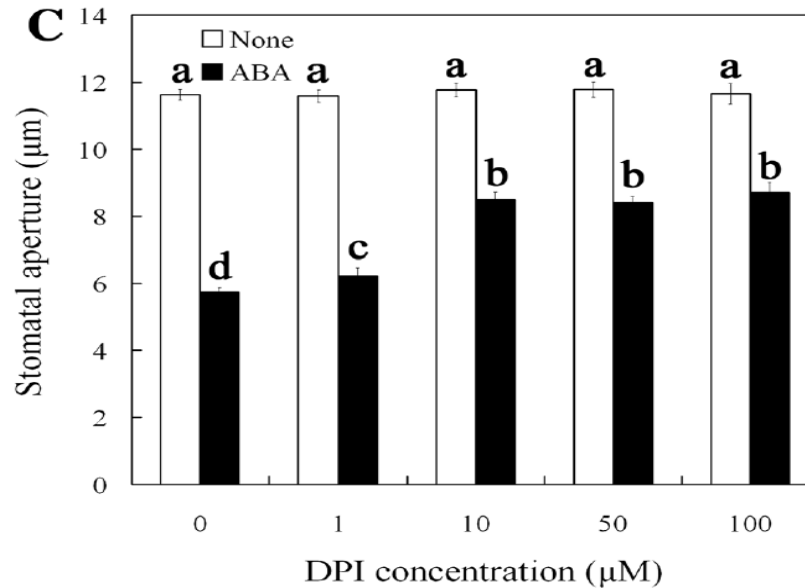




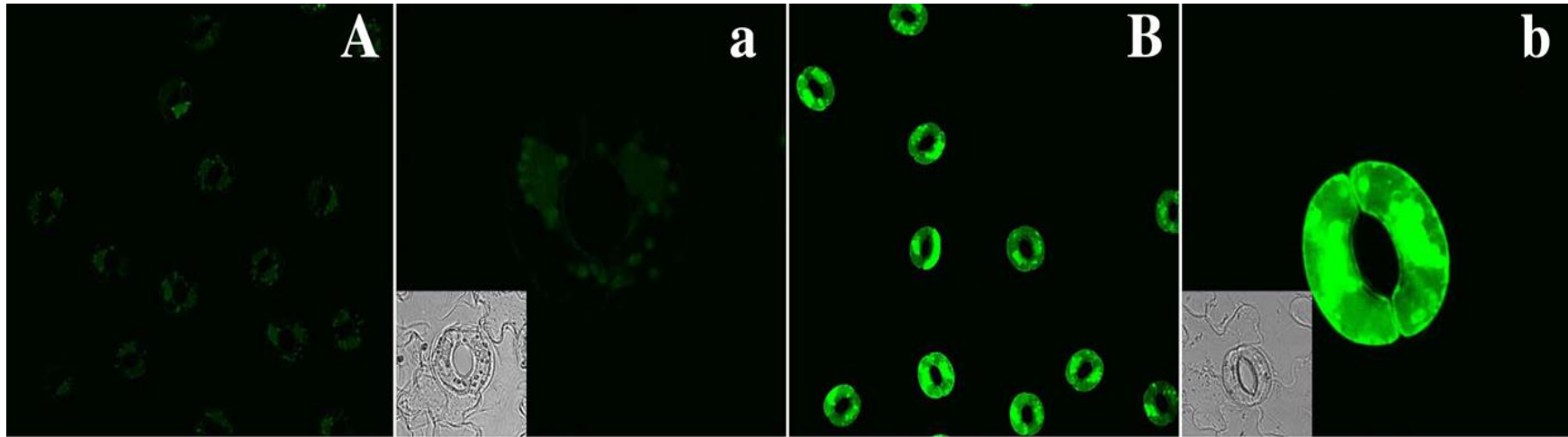
FC inhibits ABA-induced stomatal closure



CAT inhibits ABA-induced stomatal closure

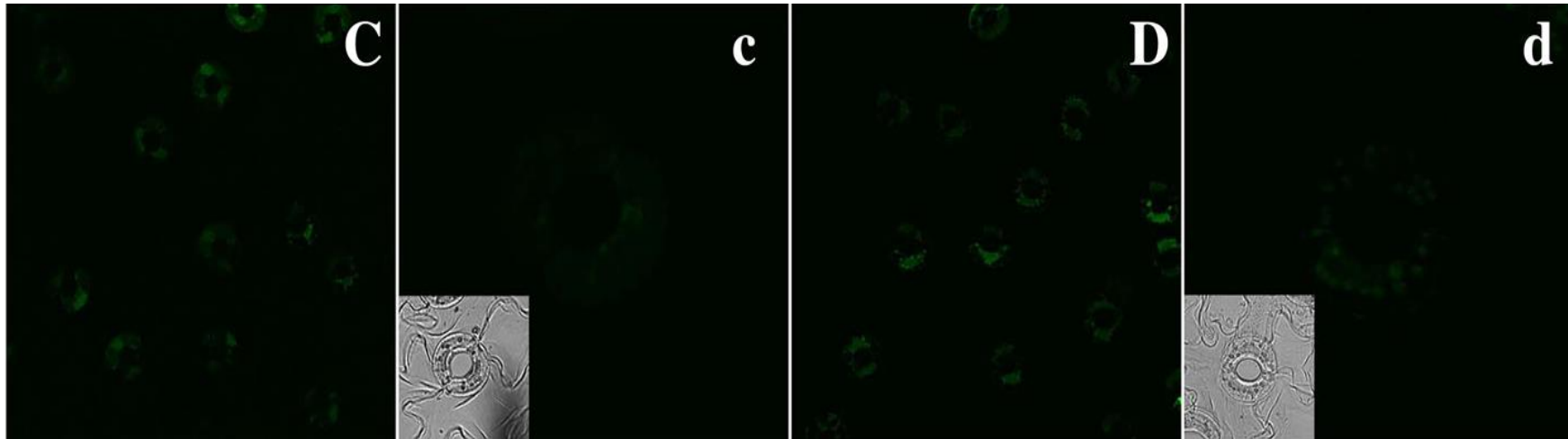


DPI inhibits ABA-induced stomatal closure



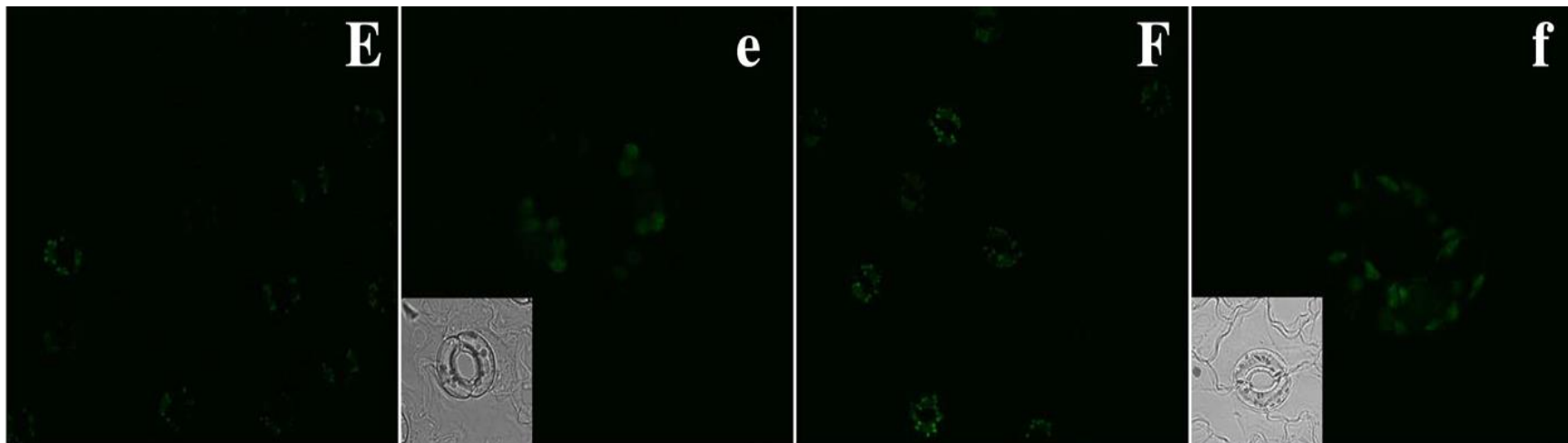
A) treated with CO₂-free

B) treated with 10 μM ABA



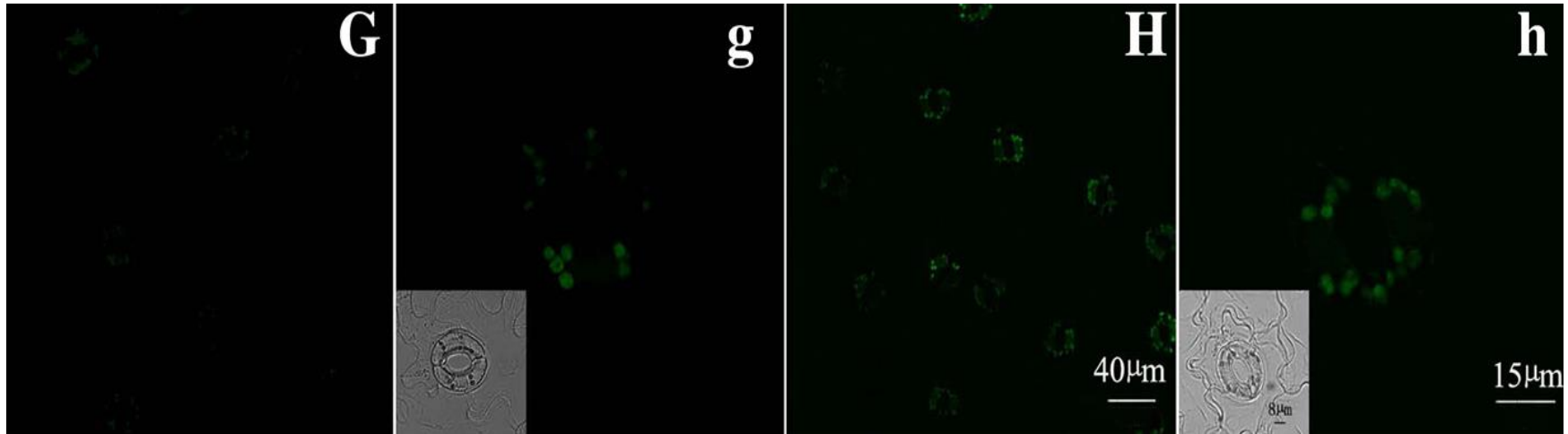
C) treated with 0.1 μM FC

D) treated with 0.1 μM FC + 10 μM ABA



E) treated with 100 units mL⁻¹ CAT

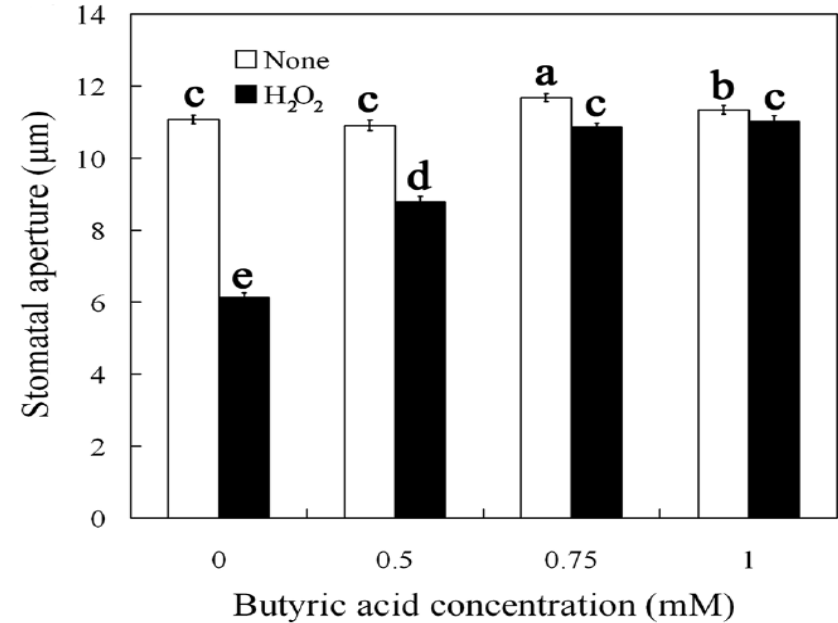
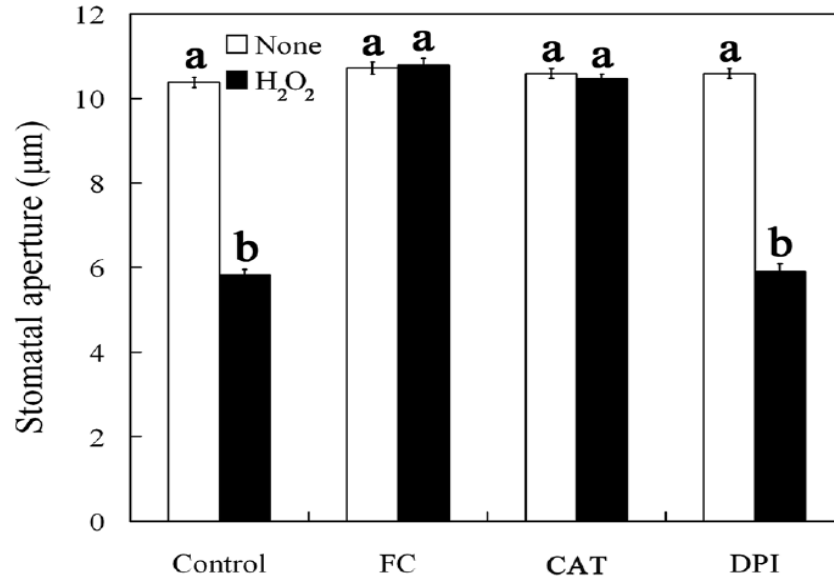
F) treated with 100 units mL⁻¹ CAT +10 μ M ABA



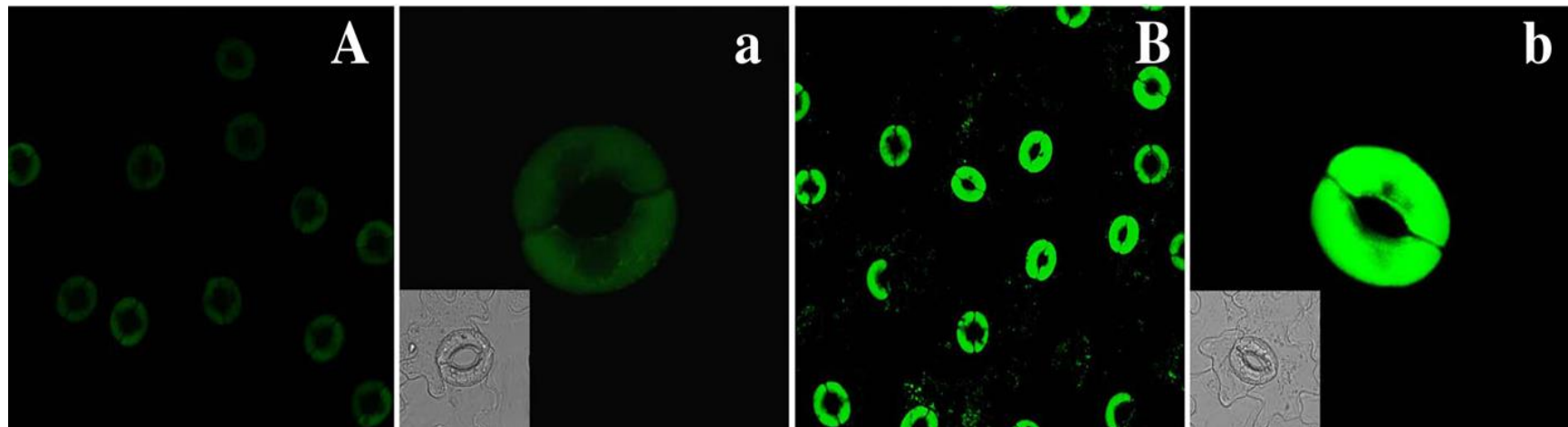
G) treated with 10 μ M DPI

H) treated with 10 μ M DPI +10 μ M ABA

Mechanism of Stomatal closure by ABA and inhibitor Compounds



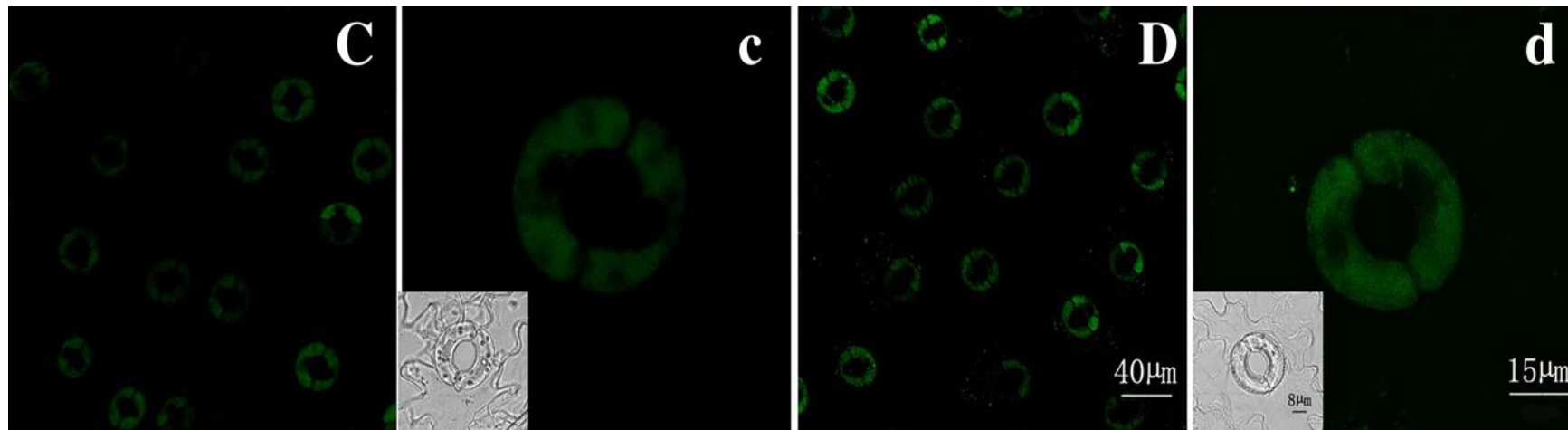
FC and butyric acid suppress exogenous H₂O₂-induced stomatal closure



A) treated with MES/KCl buffer alone

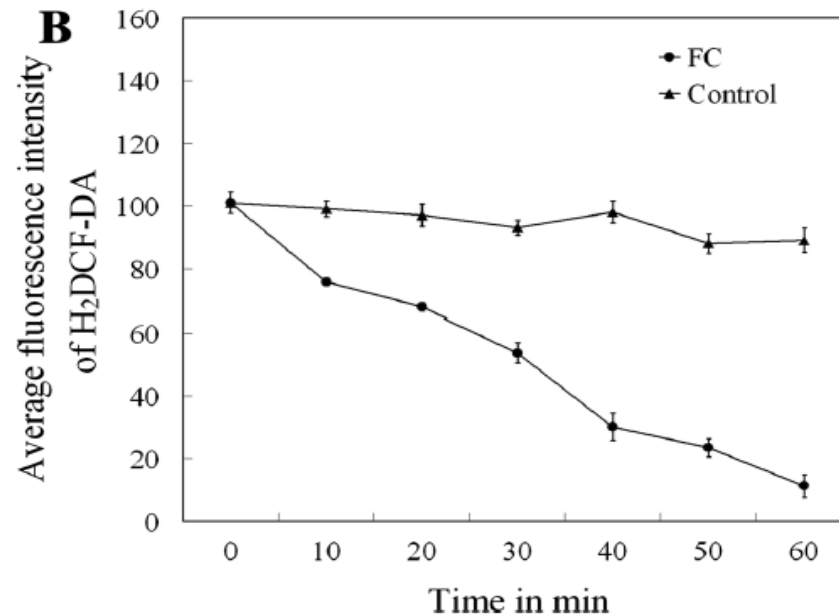
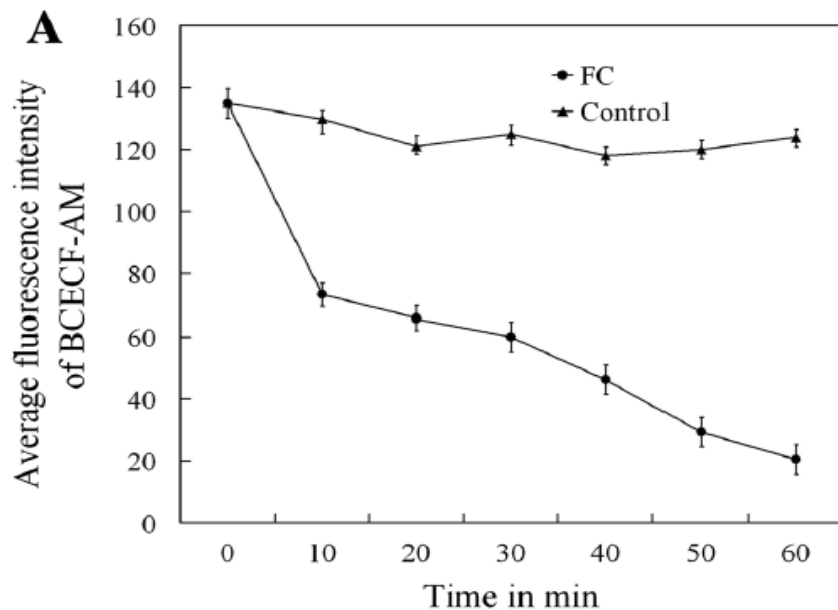
2-(N-morpholino)ethanesulfonic acid

B) treated with 10 μ M ABA



C) treated with 0.1 μM FC

D) treated with 0.1 μM FC + 10 μM ABA



Kinetics of decrease in cytosolic pH (A) or H₂O₂ levels (B) in guard cells of stomata had been closed by ABA in response to 0.1 μ M FC.



References

- 1- Beardsell, M. F., and Cohen, D. 1975. Relationships between leaf water status, abscisic acid levels, and stomatal resistance in maize and sorghum. *Plant Physiol.* 56: 207–212.
- 2- Huang, A. X., She, X.P., Zhao, J. L and Zhang, Y.Y. 2014. Inhibition of ABA-induced stomatal closure by fusicoccin is associated with cytosolic acidification-mediated hydrogen peroxide removal. *Botanical Studies.* 55:33.
- 3- Taiz, L. and Zeiger, E. 2006. *Plant Physiology*, Fifth Edition. 673 pages.
- 4- Wilkinson, S., and Davies, W. J. 1997. Xylem sap pH increase: A drought signal received at the apoplastic face of the guard cell that involves the suppression of saturable abscisic acid uptake by the epidermal symplast. *Plant Physiol.* 113: 559–573.
- 5- Zhang, J., and Zhang, X. 1994. Can early wilting of old leaves account for much of the ABA accumulation in flooded pea plants. *J. Exp. Bot.* 45: 1335–1342.

اللهم عجل لولي الفرج

